

REMARKS

Claims 1-20 remain in this application, with claims 1 and 18 amended and claim 20 added. By these amendments, no new matter has been added.

Applicants acknowledge with appreciation the indication of allowable subject matter in claims 6 and 16.

Claim 18 was objected to as containing informalities. Claim 18 has been amended, and claim 20 added, to correct the informalities noted in the Office Action. This objection should therefore be withdrawn.

Claims 1-10 were rejected under 35 U.S.C. § 101 as directed to non-statutory subject matter. These rejections are respectfully traversed. Claim 1 recites a process, the output of which is a simulated pose sequence $P(t)$. In the context of the specification, $P(t)$ is not merely an abstract number or numbers; it is tangible, concrete data for use in computer animation of an articulated figure. See, e.g., Abstract. Nonetheless, claim 1 has been amended to expressly recite the step of providing $P(t)$ to a computer for this purpose. Claim 1 therefore recites a tangible, concrete and useful result, and is therefore statutory under § 101. These rejections should therefore be withdrawn.

Claims 1, 3-5, 7-11, 13-15 and 17-20 were rejected under 35 U.S.C. § 102(b) as being anticipated by Delp, and claims 2 and 12 were rejected under 35 U.S.C. § 103(a) as unpatentable over Delp. All of the foregoing rejections are respectfully traversed.

Delp discloses software for developing, altering, and evaluating models of musculoskeletal structures. These models are built to accurately represent bio-mechanical elements such as muscle force generation, bone geometry, joint kinematics and movement dynamics. Page 47, col. 1, second full paragraph. To build a model, users define "joints," "muscles," and "tendons." Each muscle-tendon unit is user-defined by four dimensionless curves and five parameters for scaling these curves. Page 48, col. 2; Fig. 3. Delp also discloses that the musculoskeletal model can be used

in an inverse dynamics process, in which “users specify the time histories of the joint angles during an activity, and the dynamic model calculates the joint moments required to produce the specified motion.” Page 49, col. 1, section “Dynamics,” first paragraph. Delp teaches that the inverse-dynamics solution may be useful “to calculate other parameters that are not easily measured during movement, such as muscle lengths and moment arms.” Page 50, col. 2, fourth full paragraph. Unlike the present application, Delp is primarily concerned with medical or sports diagnostic applications for bio-mechanical modeling, and not for motion simulation in an animation production context. Delp is primarily concerned about modeling internal musculoskeletal forces and geometry, and is silent about modeling of external forces applied to an articulated figure.

Delp fails to disclose or suggest:

accessing force data $G(t)$, wherein $G(t)$ comprises external force values for simulating a response of the articulated figure; and
providing a sum of $F(t)$ and $G(t)$ suitable for input in simulating a dynamic response of the articulated figure using a forward-dynamics motion simulation to determine a simulated pose sequence $P(t)$

as defined by claims 1 and 11. The Office Action recites page 50, col. 1 paragraph 1 as disclosing accessing external force data $G(t)$. This is not true. Delp discloses accessing motion analysis data derived from tracking markers placed on body segments. The motion data is read and converted into an animation of the musculoskeletal model. *Id.* Delp fails to disclose or suggest modeling of input forces, i.e., external forces applied to an articulated figure.

Delp therefore fails to disclose accessing force data that comprises values *for simulating a response of the articulated figure*, as claimed. Claims 1 and 11 require that the force data comprise values for simulating a response of the articulated figure, which requires something more than static forces for maintaining a body in equilibrium, or output forces resulting from a modeled motion. The specification provides examples of the claimed forces for simulating a response as arising from collisions, such as used in

prior-art “rag-doll” modeling. Specification, page 1, lines 13-25; page 2, lines 1-9. The force data $G(t)$, as disclosed in the specification and defined by the claims, is pre-existing and, unlike Delp, is not a result of applying motion data to a model. Specification, page 14: lines 7-18. In other words, claims 1 and 11 define accessing force data that is configured and used to model *input* forces to a model of an articulated figure. In contrast, Delp is silent about modeling of input forces, and is primarily concerned with modeling internal forces in the musculoskeletal model. At most, Delp suggests calculating external forces as *output* from modeling motion of an articulated figure. See Fig. 6.

In addition, Delp fails to disclose providing a sum of the reverse-dynamics solution $F(t)$ and the external force data $G(t)$ to provide data suitable for input to a forward-dynamics motion simulation. The Office Action recites page 50, col. 1 paragraph 1 as disclosing simulating a dynamic response of an articulated figure to a sum of $F(t)$ and $G(t)$. This cannot be concluded from a fair reading of Delp. Delp discloses accessing motion analysis data derived from tracking markers placed on body segments. Page 50, col. 1 paragraph 1 The motion data is read and converted into an animation of the musculoskeletal model. *Id.* Delp discloses that the external forces are calculated by SIMM: “SIMM creates a 3D animation . . . [that] shows the timing and intensity of muscle activity and the magnitude and direction of external forces on the body.” *Id.* SIMM is software for modeling an articulated figure that includes parameters for modeling the operation of muscles and tendons. Page 47, col. 2, “How SIMM Works.”

Therefore, Delp merely discloses calculating external forces from a forward dynamics process. Separately, Delp discloses calculating internal muscle forces from an inverse-dynamics process. Page 49, col. 1, section “Dynamics,” first paragraph. But in Delp, never the twain do meet. Delp utterly fails to disclose summing an inverse-dynamics solution $F(t)$ with external force data $G(t)$ to provide data suitable for input to a forward-dynamics simulation, as claims 1 and 11 expressly define. Delp is concerned

with accurate modeling of the musculoskeletal system for use in medical applications, not with "rag-doll" modeling. It fails to disclose or suggest, either expressly or inherently, the claimed summing process.

Failing to disclose or suggest all of the claimed elements of claims 1 and 11, Delp therefore cannot anticipate these claims under § 102. The remaining rejected claims are also allowable, at least as depending from allowable base claims.

In addition, generally with respect to claims 3-5, 7 13-15 and 17, it is further noted that Delp fails to disclose or suggest scaling of $F(t)$. Claims 1 and 10 define $F(t)$ as calculated torque values for each segment of the articulated figure that would result in a defined movement. Delp discloses scaling of "dimensionless curves that represent the mechanical properties of muscle and tendon." Page 49, col. 1, paragraph 1. Delp provides further details concerning the "dimensionless curves" in Fig. 3 and its caption. From these disclosures, it is apparent that the dimensionless curves disclosed by Delp do not reasonably encompass or disclose the inverse-dynamic solution $F(t)$ defined by these claims. Each set of dimensionless curves characterizes muscle-tendon pairs for a joint of an articulated figure. In contrast, $F(t)$ comprises a set of calculated torque values for each joint of an articulated figure at different time intervals; in a figure of n joints calculated at i time intervals, $F(t)$ would populate a matrix of dimensions $n \times i$. Therefore, Delp's disclosure of scaling the dimensionless muscle-tendon curves does not amount to a disclosure of scaling $F(t)$, because differently-computed numbers, representing different things, are being scaled. Delp therefore does not anticipate these claims, which are independently allowable.

Further with respect to claims 8 and 18, Delp fails to disclose calculating $G(t)$ using $P(t)$ as input to determine collision events, whereby impulse values for $G(t)$ are calculated. The Office Action erroneously cites the bicycle riding model shown in Fig. 6 and accompanying discussion on page 52 as disclosing this element. In fact, Delp does not disclose how forces between the bike pedals and the rider were calculated. Nor has it been demonstrated that such forces must have been calculated in the claimed

manner. To the contrary, external forces could have been calculated in numerous other ways. For example, using a defined pedal mechanism, continuous contact with the rider's feet could have been assumed and output force determined from a forward-dynamics solution for a pedaling motion coupled with a defined force/speed curve for the pedaling mechanism. Because Delp fails to expressly or inherently disclose the claimed step, it cannot anticipate these claims, which are therefore independently allowable.

Further with respect to claims 9-10 and 19-20, Delp fails to fails to disclose or suggest the defined "simulating" step, as discussed above. Therefore, Delp also necessarily fails to disclose or suggest any sequence or order for performing the defined "simulating" and "calculating" steps.

In view of the foregoing, the Applicants respectfully submit that Claims 1-20 are in condition for allowance. Reconsideration and withdrawal of the rejections is respectfully requested, and a timely Notice of Allowability is solicited.

To the extent it would be helpful to placing this application in condition for allowance, the Applicants encourage the Examiner to contact the undersigned counsel and conduct a telephonic interview.

While no fees are believed due in connection with the filing of this paper, the Commissioner is authorized to charge any shortage in fees due, including extension of time fees, to Deposit Account No. 50-3683.

Respectfully submitted,

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